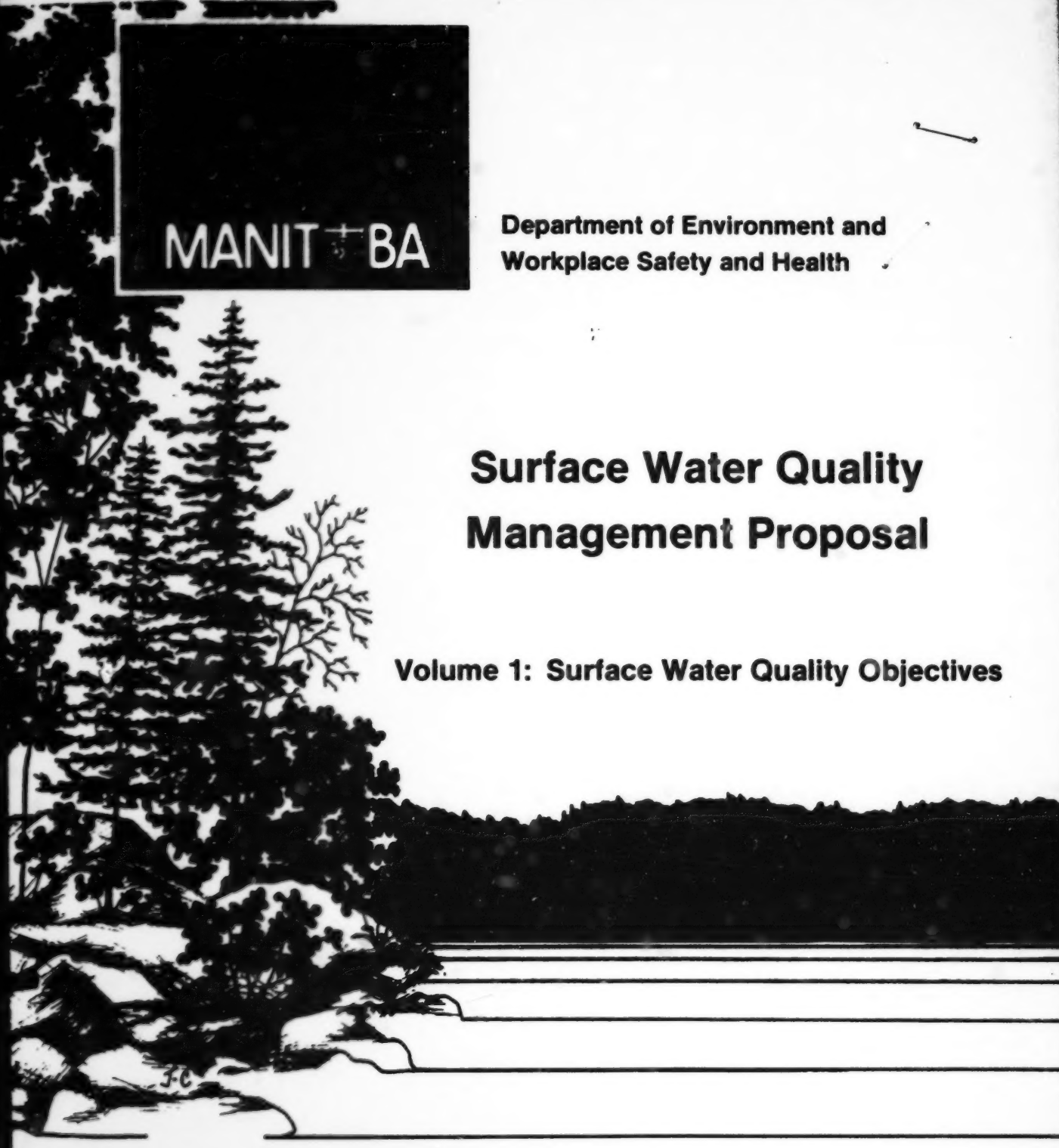




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**Department of Environment and
Workplace Safety and Health**

Surface Water Quality Management Proposal

Volume 1: Surface Water Quality Objectives

Water Standards and Studies Report #83-2

SURFACE WATER QUALITY

MANAGEMENT PROPOSAL

V o l u m e 1: Surface Water Quality Objectives

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Water Standards and Studies Report 83-2

SUMMARY

The surface waters of Manitoba are used for numerous purposes including domestic consumption, industrial uses and agricultural purposes such as irrigation and livestock watering. In addition, many surface waters are used for recreational pursuits such as swimming, water skiing, boating and the enjoyment of pleasant scenery. Most waters are also inhabited by fish life, amphibians (frogs), reptiles (turtles), aquatic insects and algae. Large forms of wildlife, small furbearing mammals, water fowl and some birds of prey rely upon surface waters for drinking purposes, habitat and sources of food supplies.

The quality of surface water has the potential to become degraded through many other uses such as the disposal of industrial and municipal effluents, development of hydroelectrical generating sites and land use practices such as agriculture and forestry.

In order to achieve harmony between the various uses, surface water quality objectives were developed which define minimum levels of quality for each of the uses that requires protection. The objectives, when not exceeded, will protect an organism, a community of organisms, a prescribed water use, or a designated multiple purpose water use with an adequate degree of safety. Specific objectives have been developed for over eighty substances.

These objectives affect all Manitobans, since if they are under protective, surface water quality may become degraded, or if they are over protective, an unnecessary burden may be imposed on taxpayers and industry in order to pay for additional waste treatment facilities.

Surface water quality objectives are primarily used by government agencies, such as the Environmental Management Division and the Clean Environment Commission, in order to assist in developing effluent discharge restrictions for industrial and municipal waste discharges. In addition, other government agencies may use the objectives to control land use practices that may have effects on water quality, such as cottage development.

The objectives are also used by the Environmental Management Division, in combination with environmental monitoring programs, to determine if pollution control measures are successful in preventing water pollution. For example, the objectives may be used to determine if the waste treatment provided by a municipal sewage lagoon is successful in preventing water pollution of a fish spawning stream.

The objectives are also used by other government agencies to determine if certain waters are suitable for uses such as irrigation.

If the objectives are exceeded, there is no direct legal recourse to the source of the pollution. However, the Environmental Management Division may conduct the necessary studies in order to determine the cause of the pollution. Should the cause be waste effluents, Clean Environment Commission Orders may be reviewed and revised in order to provide the necessary protection.

Occasionally, water quality parameters may exceed these objectives due to natural conditions. In these cases, the objectives do not apply. It is the intent that these objectives are applicable to conditions in the water that are caused by man's activities. However, if a certain parameter exceeds the objectives due to natural conditions, it would be unwise to further increase that parameter by man-made activities.

It is important to realize that scientific information is limited on all the possible effects of a pollutant in the environment. New information, however, is continually being reported. Thus, the objectives must be revised periodically in order to include the most recent scientific knowledge. Based upon the available information, these objectives are designed to afford adequate protection without an unreasonable amount of over protection or under protection.

Thousands of substances could potentially pollute Manitoba's surface waters. These include, for example, agricultural chemicals, or hazardous goods that may be transported through Manitoba. Objectives have not been developed for all possible substances that could affect water quality. However, given reasonable information that such substances are present, objectives will be developed using the best available scientific information.

Because specific numerical objectives cannot reasonably be developed for every possible chemical, physical or biological parameter, general statements concerning environmental quality are also used to protect water quality. These requirements, although written in general terms, are nevertheless water quality objectives. For example, these may be used to establish effluent limits even though there may be no specific numerical objectives applicable in the receiving water. General statements have been developed for colour, odour, taste, turbidity, deposits, floating materials, flow, litter, nutrients, oil and grease and toxic substances.

Ideally, objectives should be maintained at all times. It is however, generally accepted that to require objective maintenance at all times is unreasonable. Thus, a specific low flow level has been chosen below which the objectives do not have to be met. This flow, for large streams and rivers, is the lowest flow which, on a statistical basis, would occur for a seven consecutive day period once every ten years. For small intermittent streams this minimum flow is $0.003\text{m}^3/\text{s}$. The objectives should be maintained at all times in lakes.

Mixing zones are areas adjacent, for example, to a discharge, where the stream or lake may not meet all the water quality objectives. This is allowed for practical reasons, since for most contaminants, it would be unreasonable to expect the objectives to be met at the end of the discharge pipe. Mixing zones are therefore recognized as areas subject to a loss of value, but nevertheless, certain guidelines should be followed to ensure that the loss is kept as small as possible. These include, for example, ensuring that the entire width of rivers are not completely influenced by a discharge in such a manner that fish movement is prohibited or that bathing areas are not included in mixing zones.

Certain pristine waters support important major uses, such as recreation on surface waters within Provincial Parks. These waters may be given a "High Quality" designation. It is the intent that discharges or other activities that may affect the water quality of these areas should be very strictly controlled. Thus, development within "High Quality" surface water areas will likely be more costly than in other areas of the Province, since all available measures should be used to control environmental disturbances.

Some pristine waters of the Province may be preserved in their natural state for the future. These waters will be given an "Exceptional Value" designation. Development of any type that may affect water quality should be discouraged from these areas.

Objectives have been developed for each of the general surface water uses within Manitoba that requires protection. These are designated as classes and include domestic consumption, aquatic life and wildlife, industrial consumption, agricultural consumption, recreation and other uses. Where possible, these general classes are further divided into categories to provide protection, for example, to the different types of recreation.

CLASS 1: DOMESTIC CONSUMPTION will ensure the protection of waters that are suitable for human consumption after treatment. Since all surface waters of Manitoba are susceptible to uncontrolled microbiological contamination, for example, by wildlife, minimum treatment consisting of disinfection is required for all surface waters prior to consumption. Objectives are included for substances that may have harmful health effects, such as pesticides, toxic metals and radioactive materials and for substances that may present a nuisance to the consumer, such as excessive hardness and iron.

CLASS 2: AQUATIC LIFE AND WILDLIFE will ensure the protection of waters that are suitable for aquatic life such as fish, amphibians (frogs), reptiles (turtles) and other forms of life including aquatic insects and algae. By ensuring protection of the aquatic communities, protection is indirectly offered to those forms of wildlife that rely upon surface waters for habitat and for food supplies. These include ducks, geese, furbearing mammals such as the muskrat and birds of prey such as the eagle and osprey. Protection is also provided to those animals that use these waters for drinking purposes.

Objectives are included for numerous parameters including dissolved oxygen, toxic metals and pesticides. The presence of dissolved oxygen in water is essential for aquatic life, and the type of aquatic community is dependent to a large extent on the amount of dissolved oxygen present. Toxic metals, such as zinc and cadmium, in small concentrations, can have harmful effects on growth and reproduction, and in large concentrations, can be lethal. Others, such as mercury and PCB's, even though present in small quantities, can slowly bio-accumulate in the tissue of organisms, until higher harmful levels are reached.

Some metals, such as cadmium, are more or less toxic depending upon the hardness of the water. For this reason, a mathematical equation is used to establish an objective based upon the relationship between toxicity and hardness.

The existence and composition of an aquatic community also depends upon temperature characteristics. An excessive increase in temperature can be harmful by interfering with fish spawning cycles, causing changes in growth and respiration, and causing more heat tolerant species to replace heat sensitive ones. Heat related winter fish kills can occur when a heated discharge is suddenly stopped. Fish that have been attracted to a heated area are suddenly exposed to the cold ambient temperature.

Developing site-specific temperature objectives is complicated and time consuming. Therefore, a method is included by which temperature objectives will be developed for specific discharges.

CLASS 2: AQUATIC LIFE AND WILDLIFE is subdivided into two categories in order to provide specific protection to different general groups of aquatic life in Manitoba.

CATEGORY A: COLD WATER AQUATIC LIFE, COOL WATER AQUATIC LIFE AND WILDLIFE will provide protection to all types of aquatic life inhabiting the surface waters of Manitoba, including the protection of wildlife.

CATEGORY B: COOL WATER AQUATIC LIFE AND WILDLIFE will provide protection to cool water aquatic life such as walleye, sauger and pike, including the protection of wildlife. This category, however, will not provide adequate protection to cold water aquatic life such as trout and whitefish.

CLASS 3: INDUSTRIAL CONSUMPTION will ensure the protection of waters that are used for industrial purposes. However, objectives will not be developed at present due to the large number of present and potential industrial users, each with different quality requirements for water.

CLASS 4: AGRICULTURAL CONSUMPTION will provide protection to waters used by the market garden and farming industry for irrigation and livestock watering purposes. Objectives are included for parameters, such as sodium, that will protect various textured soils. Other objectives, such as boron, will protect sensitive plants. In addition, others, for example, fecal coliform bacteria are included that are intended to protect humans following consumption of raw vegetables irrigated with waters of this class.

This class is subdivided into four categories in order to provide protection to three different general irrigation practices plus to provide protection for livestock watering.

CATEGORY A: IRRIGATION will provide protection to waters that are used by the greenhouse industry where such water is the only source of moisture for the greenhouse plants.

CATEGORY B: IRRIGATION will provide protection to waters that are used to irrigate field crops, where such water is used to supplement natural rainfall.

CATEGORY C: IRRIGATION will provide protection to waters that are used to irrigate field crops, where such water is used to supplement natural rainfall. These waters, however, may damage certain soil types if used for long periods of time.

CATEGORY D: LIVESTOCK will provide protection to waters that are used by livestock.

CLASS 5: RECREATION will ensure that surface waters may be safely used for swimming and boating purposes and also may provide for the enjoyment of pleasant scenery. These waters provide outdoor recreational opportunities for both Manitoba residents and for tourists.

This class is further subdivided into two categories in order to provide protection to the different types of water related recreation depending upon the extent of contact with the water.

CATEGORY A: PRIMARY RECREATION will ensure the protection of waters that may be used for purposes such as swimming and water skiing, where contact with the water is an important aspect of the activity.

CATEGORY B: SECONDARY RECREATION will ensure the protection of waters that may be used for purposes such as fishing and boating, where contact with the water is only incidental to the activity.

Manitoba's surface waters may be used for other purposes that do not require protection through the establishment of objectives. These include, for example, the disposal of wastes or the generation of hydroelectrical power. Because of social or economic reasons, certain waters may be used only for these uses. Such waters may be given a **CLASS 6: OTHER USES** classification.

PREAMBLE

In 1976, the Environmental Management Division prepared a proposal outlining a system of surface water quality objectives and watershed classifications for the Province of Manitoba that would form the basis of a surface water quality management program. This proposal was critically reviewed by the Clean Environment Commission through public hearings held in 1977, under Section 13.1 of the Clean Environment Act. It was subsequently implemented with several revisions resulting from the public hearings.

Volume I, Surface Water Quality Objectives, herein, contains revised objectives which reflect current scientific knowledge and which delineate numerous changes in the water use classes and categories in order to better reflect the surface water use within Manitoba. Specific problem areas encountered in the original objectives have been further defined.

Volume 2, Watershed Classifications, under separate cover, contains a revised procedure for the application of surface water quality objectives. The surface water quality objectives will be appended for each of the nineteen watersheds within Manitoba as they become available. This document also contains a procedure for utilizing the surface water quality objectives, on an interim basis for watersheds that have not been classified.

The attached documents have been prepared by the Water Standards and Studies Section of the Environmental Management Division and have been reviewed by the Water Pollution Control Section of the Environmental Management Division, the Manitoba Departments of Agriculture, Municipal Affairs, Health, Urban Affairs, Economic Development and Tourism, Energy and Mines and the Parks, Wildlife, Resource Allocation, Fisheries and Water Resources Branches of the Manitoba Department of Natural Resources.

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Appendix 1

Table 1: General and specific surface water
quality objectives for the Province of Manitoba

ABBREVIATIONS

- (a) Bq/L = Becquerels per liter
- (b) µg/L = micrograms per liter
- (c) mg/L = milligrams per liter
- (d) µS/cm = microsiemens per centimeter
- (e) SAR = Sodium Adsorption Ratio

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1. INTRODUCTION

There are many diverse uses of surface waters within Manitoba, such as domestic, industrial and agricultural consumption, propagation and maintenance of aquatic life, wildlife, waterfowl, shorebirds and furbearing animals and recreation. These often require waters of differing physical, chemical and biological quality. These uses, plus others such as the disposal of wastes, generation of hydroelectric power, removal of excess precipitation, hydraulic alterations to natural watercourses and land use practises compete for the quality resources of provincial surface waters.

The acceptability of water is directly related to the needs of the user. Water containing a certain combination of constituents may be suitable for one use but may be totally unsuitable for another use.

The Environmental Management Division is striving to maintain, enhance and protect the chemical, physical and biological integrity of all surface waters within the Province of Manitoba. Achievement of this goal will ensure that the present and potential surface water uses are maintained in concordance with the social and economic development of the Province. To this end, surface water quality objectives were formulated which define minimum levels of quality required for the various uses. Provincial waters designated "High Quality" will be afforded greater protection and waters designated "Exceptional Value" will be maintained in their natural or non-degraded state.

If the objectives are under protective, surface water quality may become degraded, or if they are over protective, an unnecessary burden may be imposed on taxpayers and industry in order to pay for additional waste treatment facilities. These objectives, therefore, impact all Manitobans, since they may affect the operation of industries, municipalities and certain aspects of agriculture.



Figure 1: Písew Falls, located on the Grass River, is one of Manitoba's many picturesque water-related sites.

Surface water quality objectives are designated concentrations of constituents that, when not exceeded, will protect an organism, a community of organisms, a prescribed water use, or a designated multiple purpose water use with an adequate degree of safety.

Where water quality characteristics could not be defined in scientifically defensible quantitative terms, general narrative statements were developed that reflected the necessary and desirable quality.

1.1 APPLICATION OF SURFACE WATER QUALITY OBJECTIVES

Surface water quality objectives are used as a management tool suited to protecting surface water quality. The objectives are used in conjunction with ambient monitoring data:

- (a) to develop effluent discharge limitations for the protection of specific uses, through determining the capability of a receiving water course to assimilate waste contaminants. The assimilative capacity is usually the difference between objective levels and ambient levels, where the ambient levels are lower,
- (b) to develop rational policies to guide those agencies having legislative authority, in co-operation with the Environmental Management Division, for projects involving resource apportionment, such as hydrological alterations and land use practises that may contribute to water quality deterioration. Such projects include, but are not limited to:
 - (i) water flow augmentation,
 - (ii) lake level regulation,
 - (iii) water flow regulation,
 - (iv) inter-basin water transfer,
 - (v) extraction and apportionment of water for agriculture, municipal and industrial purposes,
 - (vi) construction activities,
 - (vii) resource harvesting or extraction operations (timber harvest, wild rice harvest, mineral exploration, mining, etc.),
 - (viii) apportionment of crown, municipal, or private lands for recreational or other purposes through lease, sale, subdivision, etc.

- (c) to develop best management practises to control non-point or diffuse sources of pollution,
- (d) to assess the effectiveness of pollution control measures in protecting beneficial uses, and
- (e) to identify if the ambient water can sustain specific uses.

Paramount among the above applications, is the utilization of the objectives for consideration by the Clean Environment Commission, in order to develop effluent discharge limitations necessary to make discharges compatible with specific surface water uses. The water quality objectives should not be construed as permitting any waste amenable to treatment or control to be discharged in any surface waters without treatment or control that could reasonably be expected.

If the water quality objectives are not met, there is no direct legal implication to the source of the contamination. Such a situation however, would indicate that administrative action is required to determine the cause and if remedial action is required. For example, remedial action may involve the review and revision of Clean Environment Commission orders, if point source discharges are the causative agents.

Utilization of surface water quality objectives is but one integral facet of surface water quality protection. Water quality objectives are used in conjunction with other provincial and federal guidelines and regulations on quantities, rates and concentrations of chemical, physical, biological and other constituents to which dischargers are subject.

1.2 NATURAL CHARACTERISTICS OUTSIDE THE OBJECTIVES

Waters may have, on occasion, natural characteristics outside the objectives in which case the objectives do not apply. The objectives contained herein apply to man-induced alterations. Withdrawal and subsequent discharge of such waters without alteration of the physical, chemical or biological characteristics into the same or similiar water body will not constitute violation of these objectives. The reduction in water quantity following

withdrawal but prior to discharge however, should not cause exceedences of the general or specific surface water quality objectives such that other riparian uses may be adversely affected.

It should be noted that where the assimilative capacity is utilized by inferior natural quality, further deterioration by the introduction of contaminants should not be allowed, unless such additions will not jeopardise any beneficial use as shown through site specific investigations.

1.3 LIMITATIONS AND INTERPRETATION OF SURFACE WATER QUALITY OBJECTIVES

The surface water quality objectives contained herein are based upon current scientific knowledge. Thus, they must be reviewed and revised regularly to ensure that they reflect new information on criteria and limitations and that existing or potential uses are accurately identified.

There is a great deal of uncertainty of specific cause effect relationships between all concentrations of contaminants and all environmental variables. In addition, information is scarce on the antagonistic, synergistic and additive effects of combinations of contaminants.

The objectives necessary to protect aquatic life, for example, were adopted from criteria that were developed utilizing an array of data from organisms, both plant and animal, occupying various trophic levels. Others were adopted after the application of safety factors to a limited data base. These objectives then, are designed to protect most aquatic organisms most of the time, but not necessarily all organisms all of the time.

Similarly, water used for domestic consumption which contains substances at concentrations less than the maximum acceptable objectives should be suitable for lifelong consumption. These objectives were developed in consideration of other exposure routes, such as dietary intake.

These objectives are designed to afford adequate protection, without an unreasonable amount of over protection or under protection. Hence, adverse effects may be discernible should exceedences of the objectives be prolonged.

The objectives are expressed in terms of total concentrations of constituents in whole unfiltered water, except where otherwise specified and as maximum acceptable concentrations. Maximum acceptable concentrations should be construed to mean instantaneous maximum (or minimum) concentrations not to be exceeded at any time in any place. It should be noted that certain objectives are below the present technical detection capabilities of analytical instruments. This is justifiable, however, since these objectives are useful in calculating waste load limitations.

1.4 HIGH QUALITY WATERS

Waters designated as "High Quality" should have biological, chemical and physical quality better than the established objectives. Such waters should support a high quality beneficial use. The designation "High Quality" will be used in conjunction with the respective beneficial use class or category that is determined to be of high quality. Waters suitable for inclusion are as follows:

- (a) waters that flow through or that are bounded by Provincial or National Parks,
- (b) waters within relatively undisturbed watersheds,
- (c) waters possessing outstanding quality characteristics,
- (d) waters that support a diverse or unique flora and fauna which are sensitive to man-induced water quality alterations.

Measurable or calculable degradation should not occur as a result of human activity, that will jeopardize the designated high quality use unless:

- (a) the proposed new, additional or increased discharge or discharges of pollutants is justified,
- (b) such proposed discharges will not preclude any use presently possible in such waters and downstream from such waters, and will not result in exceedences of the water quality objectives, and

- (c) any project or development which will result in new, additional or increased discharges of pollutants into such waters should be required to utilize the best available combination of treatment, land disposal, re-use and discharge technologies to control such wastes, including the use of best management practises to curb soil erosion.

1.5 EXCEPTIONAL VALUE WATERS

Any water whose quality is better than the established objectives and whose value as a resource for the support of a combination of aquatic life and wildlife and recreational uses is such that the waters are of exceptional recreational and ecological value will be given an "Exceptional Value" designation. Waters suitable for inclusion are as follows:

- (a) wild and scenic rivers or lakes,
- (b) waters or watersheds providing habitat for rare or endangered flora and fauna,
- (c) waters considered sensitive such that irreversible harm will result following human impact,
- (d) waters whose exceptional quality and value as a future resource precludes the assignment of present uses.

The above waters will be given a single "Exceptional Value" designation. This designation will be used to replace all other possible beneficial use designations. Water courses designated as such should not receive any alterations that result in measurable, calculable or perceived water quality degradation or degradation of other values deemed exceptional.

1.6 DEVELOPMENT OF SPECIFIC SURFACE WATER QUALITY OBJECTIVES

The list of specific water quality objectives does not include all possible substances that could affect water quality. Technology however, exists for the development of analytical procedures and for water quality objectives for all possible contaminants.

For example, over 600 substances are registered by Agriculture Canada as active ingredients within pest control products. These products are used for various purposes including wood preservatives, insecticides, herbicides, fungicides, materials preservatives, plant growth regulators, etc., and are available for use in Manitoba. In addition, thousands of other substances are recognized by the Environmental Management Division as hazardous goods, and are subject to manufacture, use, storage or transport within Manitoba. These products therefore, have the potential to contaminate surface waters. Analytical techniques and objectives will be developed given reasonable information that such substances are present.

For substances not listed, the general requirement from Section 1.7 that these should not be present in concentrations or combinations that injure, be toxic to, or produce adverse physiological or behavioral responses in humans, aquatic, semi-aquatic and terrestrial life should apply.

Specific numerical water quality objectives will be developed utilizing the best available scientific information. Objectives will be developed as follows for the protection of aquatic life:

1. Objectives will be developed utilizing the minimum data base concept published by the United States Environmental Protection Agency in the Federal Register, Vol. 45, No. 231, Friday, November 28, 1980, or subsequent similar methods.
2. In those cases where it has been determined that there is insufficient available data to establish a safe concentration for a pollutant, the safe concentration value should be determined by applying the appropriate application factor to the 96 hr LC_{50} value. The 96 hr LC_{50} is defined as that concentration of a toxic material or materials which kills fifty percent of bioassay test organisms in ninety-six hours. If an experimentally derived application factor does not exist for a pollutant, the following values should be used in the determination of safe concentration values:

- (a) concentrations should not exceed 0.2 of the lowest chronic dose level at which subtle and deleterious effects were noted,
- (b) concentrations of pollutants that are non-persistent or have non-cumulative effects should not exceed 0.05 of the 96 hr LC_{50} ,
- (c) concentrations of pollutants that are persistent or have accumulative effects should not exceed 0.01 of the 96 hr LC_{50} ,
- (d) concentrations of pollutants with known synergistic or antagonistic effects with pollutants in the effluent or receiving water will be established on a case-by-case basis utilizing the best available scientific data.

Objectives for other uses will be developed utilizing the best available scientific information on exposure-response data, ingestion rates, risk extrapolation techniques, exposure from sources other than surface water, and appropriate application factors dependent upon the quantity and quality of data.

1.7 GENERAL REQUIREMENTS

Because specific numerical objectives cannot reasonably be developed for every possible chemical, physical or biological parameter, the following general statements are also used to protect water quality. These statements, although written in general terms, are nevertheless water quality objectives. For example, these may be used to establish effluent limits even though there may be no specific numerical objectives applicable in the receiving water.

All waters of the Province of Manitoba should be free of constituents attributable to sewage, industrial, agricultural and other land use practices, or other man-induced point or non-point source discharges such that the following general objectives are met as minimum conditions at all times and in all places:

Parameter, Substance, or Condition

Objectives

Colour, odour, taste, turbidity

Free from materials that produce colour, odour, taste, turbidity or other conditions in such a degree as to be objectionable or to impair any beneficial use.

Deposits

None that will cause the formation of putrescent or otherwise objectionable sludge deposits.

Floating materials

Free from floating debris, oil, scum, and other floating materials in sufficient amounts to be unsightly or deleterious.

Flow

Water quantities (flows and lake levels) should not be altered to a degree which will cause exceedences of the general or specific surface water quality objectives such that beneficial uses may be adversely affected.

Litter

Free from materials such as garbage, rubbish, trash, cans, bottles, or any unwanted or discarded solid material.

Nutrients

Nitrogen, phosphorus, carbon and contributing trace elements should be limited to the extent necessary to prevent the nuisance growth and reproduction of aquatic rooted, attached and floating plants, fungi or bacteria or to otherwise render the water unsuitable for other beneficial uses.

For general guidance, unless it can be demonstrated that total phosphorus is not a limiting factor, considering the morphological, physical, chemical or other characteristics of the water body, total phosphorus should

not exceed 0.025 mg/L in any reservoir, lake, pond, or in a tributary at the point where it enters such bodies of water. In addition, total phosphorus should not exceed 0.05 mg/L in any stream except those identified in the immediately preceding statement. It should be noted that maintenance of such concentrations may not guarantee that eutrophication problems will not develop.

Oil and grease

Free from oil and grease residues which causes a visible film or sheen upon the waters or any discolouration of the surface of adjoining shorelines or causes a sludge or emulsion to be deposited beneath the surface of the water or upon the adjoining shorelines.

Toxic substances

Free from substances in concentrations or in combinations that injure, be toxic to, or produce adverse physiological or behavioral responses in humans, aquatic, semi-aquatic and terrestrial life.

1.8 MINIMUM AND MAXIMUM FLOWS AND LEVELS

Ideally, objectives should be maintained at all times. It is however, generally accepted that to require objective maintenance at all times is unreasonable. Thus, specific low flow levels have been chosen below which the objectives do not have to be met.

1.8.1 RIVERS AND STREAMS

The specific numerical water quality objectives should apply at all times except during periods when flows are less than the average minimum seven day flow which occurs once in ten years (Q_{7-10}). Should the average minimum

seven day flow with a recurrence interval of once in ten years be $0.003\text{m}^3/\text{s}$ or less, then the criteria from the following Section 1.8.2, INTERMITTENT STREAMS should apply. In cases where the stream flow is highly regulated it may not be possible to calculate the average minimum seven day flow with a recurrence interval of once in ten years. In such instances the specific numerical objectives should apply for all periods above the minimum daily discharge for the period of record after the stream flow was altered.

The specific numerical objectives should, however, apply at all times if the beneficial uses are supported because of pooling of water during periods of low natural flows. The general requirements from the preceding Section 1.7 should apply at all times regardless of the amount of flow. Minimum and maximum stream flow criteria may be developed on a site specific basis should fluctuating stream flows influence water quality such that beneficial uses will be jeopardized.

1.8.2 INTERMITTENT STREAMS

Intermittent streams and natural or man-made drainage channels receive water from precipitation from small watersheds (usually less than 1 km^2 in area), and from ground water sources, hence usually flow during short periods. Such streams however, are an integral part of the surface water resources of the Province of Manitoba. The specific numerical water quality objectives should apply to all such streams when the flow is $0.003\text{m}^3/\text{s}$ or greater. When the intermittent stream does not contain this flow, the objectives to be maintained should be those pertaining to the water body to which the intermittent stream is tributary. The specific numerical objectives should however, apply at all times if the beneficial uses are supported because of pooling during periods of low natural flows. The general requirements from the preceding Section 1.7 should apply at all times regardless of the amount of flow. Minimum and maximum stream flow criteria may be developed on a site specific basis should fluctuating stream flows influence water quality such that beneficial uses will be jeopardized.

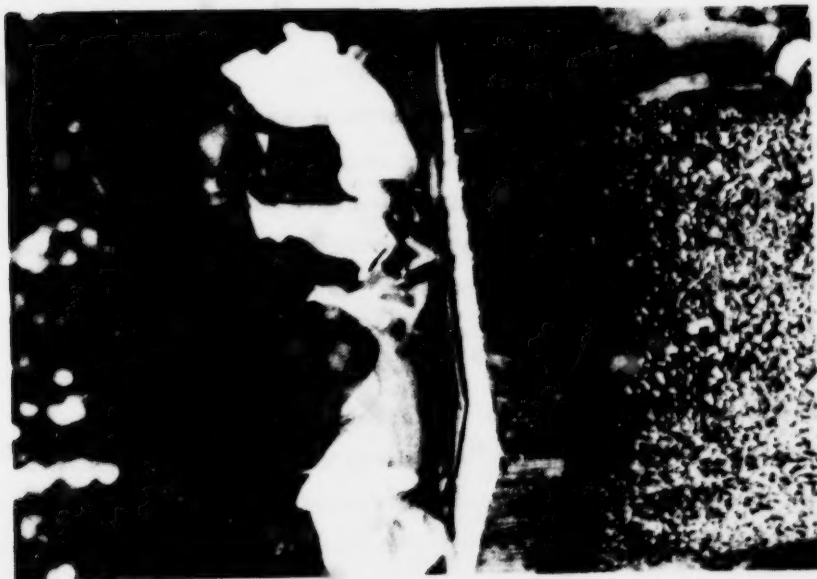


Figure 3: Water for domestic consumption should be safe, palatable and aesthetically pleasing.



Figure 2: This tributary to the Shell River flows for only a short period of time each year, thus, is considered an intermittent stream.

1.8.3 LAKES, BAYS AND IMPOUNDMENTS

The surface water quality objectives should apply at all times to lakes, bays and impoundments. Site specific water quality management strategies may be developed, delineating maximum and minimum levels, when natural or man-made lake level fluctuations cause water quality deterioration such that beneficial uses are jeopardized.

1.9 MIXING ZONES

Mixing zones are areas adjacent to a discharge or to an activity that may affect water quality where a receiving water may not meet all the water quality objectives. This is allowed for practical reasons, since for most contaminants, it would be unreasonable to expect the objectives to be met at the end of the discharge pipe. Wastes and water are given an area to mix such that the water quality objectives are met at the boundaries of the mixing zone. Mixing zones are recognized as areas subject to loss of value, however they should not be construed as a substitute for waste discharge treatment.

Mixing zones should be determined on a case-by-case basis utilizing a thorough knowledge of local conditions. Normally, geometric size constraints will not be assigned due to the complex nature of the mixing properties of liquids. The following guidelines should apply to mixing zones where applicable:

- (a) the mixing zone should be as small as practicable and should not be of such size or shape as to cause or contribute to the impairment of water uses,
- (b) the mixing zone should contain not more than 25% of the cross-sectional area/volume of flow at any transect in the receiving water during all flow regimes when the specific water quality objectives are applicable,
- (c) the mixing zone should be designed to allow an adequate zone of passage for the movement or drift of all stages of aquatic life,

- (d) mixing zones should not interfere with the migratory routes, natural movements, survival, reproduction, growth or increase the vulnerability to predation of any representative aquatic species,
- (e) mixing zones should not interfere with spawning and nursery areas,
- (f) when two or more mixing zones are in close proximity, they should be so defined that a continuous passageway for aquatic life is available,
- (g) in lakes and other surface impoundments, the volume of mixing zones should not exceed 10% of the volume of that portion of the receiving waters available for mixing,
- (h) mixing zones should not cause an irreversible organism response,
- (i) mixing zones should not intersect the mouths' of rivers,
- (j) the 96 hr LC₅₀ for indigenous fish species should not be exceeded at any point in the mixing zones,
- (k) mixing zones should not contaminate natural sediments so as to cause or contribute to exceedences of the water quality objectives outside the mixing zone,
- (l) mixing zones should not intersect domestic water supply intakes or bathing areas,
- (m) the general requirements from the preceding Section 1.7 should apply at all points within the mixing zones.

2. BENEFICIAL USES

The following sections are separated into classes that represent general surface water uses within Manitoba. These include domestic consumption, aquatic life and wildlife, industrial consumption, agricultural consumption, recreation and other uses. Where possible, these general classes are further divided into categories to provide protection, for example, to the different types of recreation.

2.1 CLASS 1: DOMESTIC CONSUMPTION

This class will ensure the protection of waters that are suitable for human consumption, culinary or food processing purposes, and other household purposes after treatment in order that the treated water will not exceed the

maximum acceptable concentrations of the "Guidelines for Canadian Drinking Water Quality," 1978, published by Health and Welfare Canada, and any revisions, amendments or supplements, thereto.

The specific requirements listed hereunder are a combination of maximum acceptable concentrations and objective concentrations as set forth in the above mentioned guidelines and guidelines utilized by the Province of Manitoba. Inherent in these requirements is the necessity to disinfect all raw surface water supplies as minimum treatment prior to consumption, since all surface waters of Manitoba are susceptible to uncontrolled microbiological contamination, for example, by wildlife.

Some surface waters of the Province of Manitoba normally exceed several of these requirements due to natural or background occurrences. Partial, complete or a combination of conventional and unit processes then become necessary in order to produce potable water from such raw water supplies. Specific requirements will not be developed for every possible combination of existing or available treatment processes.

Rather, it is the intent that man-induced water quality alterations not cause an unacceptable increased risk to public health or an unacceptable increased treatment cost to the water user or supplier. The following maximum acceptable objectives should be used, on a site specific basis, to assist in determining when increased health risks or increased treatment costs may be expected, in conjunction with information concerning:

- (a) the chemical, physical or biological quality of the proposed discharge or alteration being considered,
- (b) ambient or background surface water quality,
- (c) design of downstream water treatment facilities,
- (d) other pertinent information.

2.1.1 SPECIFIC REQUIREMENTS

2.1.1.1 RECOMMENDED LIMITS FOR PHYSICAL CHARACTERISTICS

<u>Parameter</u>	<u>Maximum Acceptable</u>
Colour	15 True Colour Units
Odour	Inoffensive
pH	6.5 - 8.5 pH Units
Taste	Inoffensive
Turbidity	5 Nephelometric Turbidity Units

2.1.1.2 RECOMMENDED LIMITS FOR CHEMICAL SUBSTANCES RELATED TO HEALTH

<u>Substance</u> ¹	<u>Maximum Acceptable</u>
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Inorganic

Antimony	0.0002 mg/L
Arsenic	0.05 mg/L
Barium	1.0 mg/L
Boron	5.0 mg/L
Cadmium	0.005 mg/L
Chromium	0.05 mg/L
Cyanide (Free)	0.2 mg/L
Fluoride	1.5 mg/L
Lead	0.05 mg/L
Mercury	0.001 mg/L
Nitrate (as N) ²	10.0 mg/L
Nitrite (as N) ²	1.0 mg/L
Selenium	0.01 mg/L

Silver	0.05	mg/L
Sodium	400.	mg/L
Sulphate	500.	mg/L
Uranium	0.02	mg/L

Organic

Nitrilotriacetic Acid (NTA)	0.05	mg/L
Pesticides (Total) ³	0.1	mg/L
Trihalomethanes (Total potential) ⁴	0.35	mg/L

1. Unless otherwise stated the limits refer to the sum of all forms present.
2. Where both nitrate and nitrite are present, the total nitrate, plus nitrite-nitrogen should not exceed 10 mg/L.
3. For maximum acceptable concentrations of individual pesticides see Section 2.1.1.3.
4. Comprise chloroform, bromodichloromethane, chlorodibromomethane and bromoform.

2.1.1.3 RECOMMENDED LIMITS FOR PESTICIDES

<u>Pesticide</u> ¹	<u>Maximum Acceptable</u>	
Aldrin and Dieldrin	0.0007	mg/L
Carbaryl	0.07	mg/L
Chlordane (Total Isomers)	0.007	mg/L

DDT (Total Isomers)	0.03	mg/L
Diazinon	0.014	mg/L
Endrin	0.0002	mg/L
Heptachlor and Heptachlor Epoxide	0.003	mg/L
Lindane	0.004	mg/L
Methoxychlor	0.1	mg/L
Methyl Parathion	0.007	mg/L
Parathion	0.035	mg/L
Toxaphene	0.005	mg/L
2, 4-D	0.1	mg/L
2, 4, 5 - TP	0.01	mg/L
Total Pesticides ²	0.1	mg/L

1. The limits for each pesticide refer to the sum of all forms present.
2. The "Total Pesticides" limit applies to water in which more than one of the above pesticides is present, in which case, the sum of their concentrations should not exceed 0.1 mg/L.

2.1.1.4 RECOMMENDED LIMITS FOR SUBSTANCES RELATED TO AESTHETIC AND OTHER CONSIDERATIONS

<u>Contaminant</u>	<u>Maximum Acceptable</u>
Chloride	250. mg/L
Copper	1.0 mg/L
Hardness (as CaCO ₃)	200. mg/L
Hydrogen Sulfide (as H ₂ S)	0.05 mg/L

Iron	0.3	mg/L
Manganese	0.05	mg/L
Phenols	0.002	mg/L
Total Dissolved Solids	500.	mg/L
Zinc	5.0	mg/L

2.1.1.5 RECOMMENDED LIMITS FOR RADIONUCLIDES

<u>Radionuclides</u>	<u>Maximum Acceptable</u>
Cesium - 137	50 Bq/L
Iodine - 131	10 Bq/L
Radium - 226	1 Bq/L
Strontium - 90	10 Bq/L
Tritium	40000 Bq/L

Where two or more radionuclides affecting the same organ or tissue are found to be present, the following relationship, based on the International Commission on Radiological Protection publication 26, should be satisfied:

$$\frac{c_1}{C_1} + \frac{c_2}{C_2} + \dots + \frac{c_i}{C_i} \leq 1$$

Where c_1 , c_2 , c_i are the observed concentrations, and C_1 , C_2 , C_i are the maximum acceptable concentrations for each contributing radionuclide.

2.1.1.6 RECOMMENDED LIMITS FOR MICROBIOLOGICAL CHARACTERISTICS

Indicator Organism

Maximum Acceptable

Fecal coliform bacteria	90 percentile: 10 organisms/100mL
Total coliform bacteria	90 percentile: 100 organisms/100mL

2.2 CLASS 2: AQUATIC LIFE AND WILDLIFE

2.2.1 CATEGORY A: COLD WATER AQUATIC LIFE, COOL WATER AQUATIC LIFE AND WILDLIFE

This category will ensure the passage, maintenance and propagation of fish species including the family Salmonidae (char, trout, whitefish, grayling) and additional flora and fauna which are indigenous to a cold water habitat. This category will also ensure the passage, maintenance and propagation of fish species and additional flora and fauna which are indigenous to a cool water habitat (mooneye, goldeye, pike, perch, walleye, sauger). Additional flora and fauna includes other aquatic organisms but not limited to bacteria, fungi, algae, aquatic insects, other aquatic invertebrates, reptiles, amphibians and fishes.

By ensuring protection of the aquatic communities, protection is indirectly offered to those forms of wildlife that rely upon surface waters for habitat and for food supplies.

This category will therefore ensure the protection of streams, lakes, marshes, swamps, lowlands, etc. which are satisfactory as habitat for aquatic and semi-aquatic wild animals, such as waterfowl, shorebirds, furbearing mammals and other water oriented wildlife including the necessary aquatic organisms in their food chain. Protection of waters suitable for watering wild animals will be provided.

Objectives are included for numerous parameters including dissolved oxygen, toxic metals and pesticides. The presence of dissolved oxygen in water is essential for aquatic life, and the type of aquatic community is dependent to a large extent on the amount of dissolved oxygen present. Toxic metals, such as zinc and cadmium, in small concentrations, can have harmful effects on growth and reproduction, and in large concentrations, can be lethal. Others, such as mercury and PCB's, even though present in small quantities, can slowly bio-accumulate in the tissue of organisms, until higher harmful levels are reached.

Some metals, such as cadmium, are more or less toxic depending upon the hardness of the water. For this reason, a mathematical equation is used to establish an objective based upon the relationship between toxicity and hardness.

The existence and composition of an aquatic community also depends upon temperature characteristics. An excessive increase in temperature can be harmful by interfering with fish spawning cycles, causing changes in growth and respiration, and causing more heat tolerant species to replace heat sensitive ones. Heat related winter fish kills can occur when a heated discharge is suddenly stopped. Fish that have been attracted to a heated area are suddenly exposed to the cold ambient temperature.

Developing site-specific temperature objectives is complicated and time consuming. Therefore, a method is included by which temperature objectives will be developed for specific discharges.

2.2.1.1 SPECIFIC REQUIREMENTS

<u>Parameter</u>	<u>Maximum Acceptable Concentration</u>	<u>Reference</u>
Ammonia (un-ionized, NH_3)	0.02* mg/L	EPA (1976)

*the percent un-ionized ammonia can be calculated for any temperature and pH by using

the following formula taken from Thurston, R.V., et al, 1974. Aqueous ammonia equilibrium calculations. Technical report number 74-1, Fisheries Bioassay Laboratory, Montana State University, Bozeman, Montana, 18 pages.

$$f = \frac{1}{10^{(pKa - pH)} + 1} \times 100$$

where:

f = the percent of the total ammonia in the un-ionized state,

pKa (dissociation constant for ammonia) =

$$0.0901821 + \frac{2729.92}{T}$$

T = temperature in degrees Kelvin
(273.16° Kelvin = 0° Celsius)

Arsenic (Total)	0.05 mg/L	Environment Canada (1979)
Cadmium (Total)	$e^{(1.05 (\ln (\text{hardness})) - 8.53)}$,	EPA (1980)
	where hardness is expressed in mg/L as CaCO ₃ (eg) 50 mg/L CaCO ₃ $\equiv$ 0.012 μ g/L 100 mg/L CaCO ₃ $\equiv$ 0.025 μ g/L 200 mg/L CaCO ₃ $\equiv$ 0.051 μ g/L	
Chlordane	0.0043 μ g/L	EPA (1980)
Chlorine (Total residual)	0.002 mg/L	EPA (1976)
Chromium (Total hexavalent)	0.29 μ g/L	EPA (1980)
Copper (Total)	5.6 μ g/L	EPA (1980)
Cyanide, Free (sum of HCN and CN ⁻ , expressed as CN)	3.5 μ g/L	EPA (1980)
DDT and metabolites	0.0010 μ g/L	EPA (1980)
Dieldrin	0.0019 μ g/L	EPA (1980)
Dissolved oxygen	60% saturation (instantaneous minimum)	Davis (1975)



Figure 4: These various species of algae form an important link in the food chain of higher organisms, such as fish. However, given the necessary enriched conditions, algae may proliferate until nuisance conditions are reached.



Figure 5: Manitoba's surface waters abound with species of fish such as this pearl dace. Larger forage fish, such as walleye, rely upon these plus many other species as a source of food supply.

Endosulfan	0.056 µg/L	EPA (1980)
Endrin	0.0023 µg/L	EPA (1980)
Heptachlor	0.0038 µg/L	EPA (1980)
Hexachlorobutadiene (HCBd)	0.1 µg/L	Environment Canada (1983)
Hydrogen Sulphide (H ₂ S)	0.002 mg/L	EPA (1976)
Iron (Total)	1.0 mg/L	EPA (1976)
Lead (Total)	$e(2.35 (\ln(\text{hardness})) - 9.48)$, where hardness is expressed in mg/L as CaCO ₃ (eg) 50 mg/L CaCO ₃ $\equiv$ 0.75 µg/L 100 mg/L CaCO ₃ $\equiv$ 3.8 µg/L 200 mg/L CaCO ₃ $\equiv$ 20.0 µg/L	EPA (1980)
Lindane	0.080 µg/L	EPA (1980)
Mercury (Total)	0.00057 µg/L	EPA (1980)
Nickel (Total)	$e(0.76 (\ln(\text{hardness})) + 1.06)$, where hardness is expressed in mg/L as CaCO ₃ (eg) 50 mg/L CaCO ₃ $\equiv$ 56 µg/L 100 mg/L CaCO ₃ $\equiv$ 96 µg/L 200 mg/L CaCO ₃ $\equiv$ 160 µg/L	EPA (1980)
Non-filterable residue	25 mg/L	Alabaster & Lloyd (1982)
pH	6.5 - 9.0 pH units	Alabaster & Lloyd (1982)
Phenols	1.0 µg/L	EPA (1976)
Phthalic acid esters		
(i) Dibutylphthalate (DBP)	4.0 µg/L	Environment Canada (1983)
(ii) Di-(2-ethylhexyl) phthalate (DEHP)	0.6 µg/L	Environment Canada (1983)
(iii) Other phthalates	0.2 µg/L	Environment Canada (1983)
Polychlorinated biphenyls	0.014 µg/L	EPA (1980)

Selenium (Total selenite)	35 µg/L	EPA (1980)
Silver (Total)	0.1 µg/L	Environment Canada (1979)
Temperature	Site specific objectives will be developed considering the following:	EPA (1976)
	1. Thermal additions should be such that thermal stratification and subsequent turnover dates are not altered from those existing prior to the addition of heat from artificial origin. 2. One limit which consists of a maximum weekly average temperature that: (a) In the warmer months is determined by adding to the physiological optimum temperature (usually for growth) a factor calculated as one-third of the difference between the ultimate upper incipient lethal temperature and the optimum temperature for the most sensitive important species (and appropriate life stages) that normally is found at that location and time, (b) in the colder months is an elevated temperature that would still ensure that important species would survive if the temperature suddenly dropped to the normal ambient temperature, or (c) during reproduction seasons meets specific site requirements for successful migration, spawning, egg incubation, and other reproductive functions of important species, or (d) at a specific site is found necessary to preserve normal species diversity or prevent undesirable growths of nuisance organisms. 3. A second limit which is the time-dependent maximum temperature for short exposures.	



Figure 6: Amphibians, such as this leopard frog, rely upon surface waters for habitat and for sources of food supplies.



Figure 7: Canada geese are often seen in association with Manitoba's lakes and marshes.

4. Maximum limits may be specified for incremental temperature fluctuations necessary to protect aquatic life from sudden temperature changes.

Toxaphene	0.013 µg/L	EPA (1980)
Zinc (Total)	47 µg/L	EPA (1980)

2.2.2 CATEGORY B: COOL WATER AQUATIC LIFE AND WILDLIFE

This category will ensure the passage, maintenance and propagation of fish species and additional flora and fauna which are indigenous to a cool water habitat (mooneye, goldeye, pike, perch, walleye, sauger). This category also includes other aquatic organisms but not limited to bacteria, fungi, algae, aquatic insects, other aquatic invertebrates, reptiles, amphibians and fishes that are indigenous to a cool water habitat.

This category will also ensure the protection of streams, lakes, marshes, swamps, lowlands, etc. which are satisfactory as habitat for aquatic and semi-aquatic wild animals, such as waterfowl, shorebirds, furbearing mammals and other water oriented wildlife including the necessary aquatic organisms in their food chain. Protection of waters suitable for watering wild animals is provided.

2.2.2.1 SPECIFIC REQUIREMENTS

All parameters and limitations from Section 2.2.1.1 should apply except as follows:

<u>Parameter</u>	<u>Maximum Acceptable Concentration</u>	<u>Reference</u>
Chlorine (Total residual)	0.01 mg/L	EPA (1976)
Dissolved oxygen	47% saturation (instantaneous minimum)	Davis (1975)

2.3 CLASS 3: INDUSTRIAL CONSUMPTION

This class will ensure the protection of all waters which are or may be used as a source of supply for industrial processes or cooling water, or any other industrial or commercial purposes and for which quality control is or may be necessary.

Discharges or alterations to waters classified as CLASS 3: INDUSTRIAL CONSUMPTION, should not be permitted such that downstream present or potential industrial users will incur unacceptable additional treatment costs.

2.3.1 SPECIFIC REQUIREMENTS

Selective limits will be imposed for any specific water as required. Objectives will not be formulated at present due to the large number of present and potential industrial water users, each with varying requirements for quality control of water.

2.4 CLASS 4: AGRICULTURAL CONSUMPTION

2.4.1 CATEGORY A: IRRIGATION (Sole Source of Water)

This category will ensure the long term protection of fine, medium and coarse textured soils from the accumulation of substances that may be harmful or cause a reduction in fertility; will ensure the protection of sensitive, semi-tolerant and tolerant species of plants; and will ensure the protection of humans from the harmful effects caused by the accumulation of substances on marketable produce that may not be processed prior to consumption. This category will provide protection for intensive horticultural crop production, where irrigation is used as the only source of water.



Figure 8: The La Salle River is used as a source of irrigation water for vegetable crops.



Figure 9: Many streams, such as the Shell River, are used for watering livestock. It is however, considered environmentally unacceptable to allow livestock direct access to the river.

Objectives are included for parameters such as sodium, that will protect various textured soils. Other objectives, such as boron, will protect sensitive plants. In addition, others, for example, fecal coliform bacteria are included that are intended to protect humans following consumption of raw vegetables irrigated with water of this class.

2.4.1.1 SPECIFIC REQUIREMENTS

<u>Parameter</u>	<u>Maximum Acceptable Concentration</u>	<u>Reference</u>
Aluminum (Total)	5.0 mg/L	NAS/NAE (1973)
Arsenic (Total)	0.1 mg/L	Environment Canada (1979)
Beryllium (Total)	0.1 mg/L	NAS/NAE (1973)
Boron (Total)	0.5 mg/L	Best professional, judgement (Manitoba Agriculture)
Cadmium (Total)	0.01 mg/L	Environment Canada (1979)
Chloride (Soluble)	68 mg/L	Best professional judgement (Manitoba Agriculture)
Chromium (Total)	0.1 mg/L	Environment Canada (1979)
Cobalt (Total)	0.05 mg/L	NAS/NAE (1973)
Conductivity	1000 μ S/cm	Best professional judgement (Manitoba Agriculture)
Copper (Total)	0.2 mg/L	Environment Canada (1979)
Fecal coliform bacteria	(a) geometric mean: 1000 organisms /100 mL (b) individual maximum: 2000 organisms/100 mL (sufficient samples should be collected in order to permit valid interpretation).	NAS/NAE (1973)

Should contact with the irrigation water by field staff be probable, the fecal coliform bacteria characteristics from the following Section 2.5, CLASS 5: RECREATION, CATEGORY A: PRIMARY RECREATION should apply.

Filterable residue	700 mg/L	Best professional judgement (Manitoba Agriculture)
Fluoride (Total)	1.0 mg/L	NAS/NAE (1973)
Hydrogen sulfide (H ₂ S)	3.0 mg/L	Best professional judgement (Manitoba Agriculture)
Iron (Total)	5.0 mg/L	NAS/NAE (1973)
Lead (Total)	5.0 mg/L	Environment Canada (1979)
Lithium (Total)	2.5 mg/L	NAS/NAE (1973)
Manganese (Total)	0.2 mg/L	NAS/NAE (1973)
Molybdenum (Total)	0.01 mg/L	NAS/NAE (1973)
Nickel (Total)	0.2 mg/L	Environment Canada (1979)
pH	6.0-8.5 pH units	Best professional judgement (Manitoba Agriculture)
Radionuclides	The limits from the preceding Section 2.1.1.5, RECOMMENDED LIMITS FOR RADIONUCLIDES should apply.	Health and Welfare Canada (1978)
Selenium (Total)	0.02 mg/L	Environment Canada (1979)
Sodium	(a) 20 mg/L	Best professional judgement (Manitoba Agriculture)
	(b) 4.0 Sodium Adsorption Ratio (SAR)	NAS/NAE (1973)

$$SAR = \frac{.043 Na^+}{\sqrt{.025 Ca^{++} + .04 Mg^{++}}}$$

expressed in mg/L

Sulfates	250 mg/L	Best professional judgement (Manitoba Agriculture)
Vanadium (Total)	0.1 mg/L	NAS/NAE (1973)
Zinc (Total)	2.0 mg/L	NAS/NAE (1973)

2.4.2 CATEGORY B: IRRIGATION (Supplemental Source of Water)

This category will ensure the long term protection of fine, medium and coarse textured soils from the accumulation of substances that may be harmful or cause a reduction in fertility; will ensure the protection of sensitive, semi-tolerant and tolerant species of plants; and will ensure the protection of humans from harmful effects caused by the accumulation of substances on marketable produce that may not be processed prior to consumption. This category will provide protection for field crop production where irrigation water is used to supplement natural precipitation. This category may be applicable only during the irrigation season.

2.4.2.1 SPECIFIC REQUIREMENTS

The maximum acceptable concentrations for parameters listed in the preceding Section 2.4.2.1 should apply with the following exceptions:

<u>Parameter</u>	<u>Maximum Acceptable Concentration</u>	<u>Reference</u>
Boron (Total)	1.0 mg/L	Best professional judgement (Manitoba Agriculture)
Chloride (Soluble)	150 mg/L	Best professional judgement (Manitoba Agriculture)

Conductivity	1,500 $\mu\text{S}/\text{cm}$	Best professional judgement (Manitoba Agriculture)
Filterable residue	1,050 mg/L	Best professional judgement (Manitoba Agriculture)
pH	5.0-9.0 pH units	Best professional judgement (Manitoba Agriculture)
Sodium	6.0 Sodium Adsorption Ratio (SAR)	NAS/NAE (1973)

$$\text{SAR} = \frac{.043 \text{ Na}^+}{\sqrt{.025 \text{ Ca}^{++} + .04 \text{ Mg}^{++}}}$$

expressed in mg/L

2.4.3 CATEGORY C: IRRIGATION (Qualified Use of Water)

This category will ensure the long term protection of coarse soils, protection up to twenty years of medium to fine textured soils, and short term protection of fine textured soils from the accumulation of substances that may be harmful or cause a reduction in fertility; will ensure the protection of sensitive, semi-tolerant and tolerant species of plants; and will ensure the protection of humans from harmful effects caused by the accumulation of substances on marketable produce that may not be processed prior to consumption. This category will provide protection for permanent irrigation installations on coarse soils and for temporary irrigation installations on medium to fine soils where irrigation water is used to supplement natural precipitation. This category may be applicable only during the irrigation season.

2.4.3.1 SPECIFIC REQUIREMENTS

The maximum acceptable concentrations for parameters listed in the preceding Section 2.4.2.1 should apply with the following exceptions:

<u>Parameter</u>	<u>Maximum Acceptable Concentration</u>	<u>Reference</u>
Aluminum (Total)	20.0 mg/L	NAS/NAE (1973)
Arsenic (Total)	2.0 mg/L	NAS/NAE (1973)
Beryllium (Total)	0.5 mg/L	NAS/NAE (1973)
Boron (Total)	2.0 mg/L	NAS/NAE (1973)
Chromium (Total)	1.0 mg/L	NAS/NAE (1973)
Cobalt (Total)	5.0 mg/L	NAS/NAE (1973)
Conductivity	2000 μ S/cm	Best professional judgement (Manitoba Agriculture)
Copper (Total)	5.0 mg/L	Environment Canada (1979)
Filterable residue	1400 mg/L	Best professional judgement (Manitoba Agriculture)
Fluoride (Total)	15.0 mg/L	NAS/NAE (1973)
Iron (Total)	20.0 mg/L	NAS/NAE (1973)
Lead (Total)	10.0 mg/L	Environment Canada (1979)
Manganese (Total)	10.0 mg/L	NAS/NAE (1973)
Nickel (Total)	2.0 mg/L	Environment Canada (1979)
Selenium (Total)	0.05 mg/L	Environment Canada (1979)
Sodium	8.0 Sodium Adsorption Ratio (SAR)	NAS/NAE (1973)
$SAR = \frac{0.043 Na^+}{\sqrt{0.025 Ca^{++} + 0.04 Mg^{++}}}$ expressed in mg/L		
Vanadium (Total)	1.0 mg/L	NAS/NAE (1973)
Zinc (Total)	10.0 mg/L	NAS/NAE (1973)

2.4.4 CATEGORY D: LIVESTOCK

This category will ensure the protection of all classes and ages of livestock and poultry from inhibitory effects following water consumption. Adjustment problems, such as mild and temporary diarrhea, may result when the livestock are introduced to the water, but should not affect their health or performance. Disinfection may be required for waters heavily contaminated with wastes of fecal origin in order to provide a suitable supply for ingestion by monogastric animals (poultry, swine, horses).

2.4.4.1 SPECIFIC REQUIREMENTS

<u>Parameter</u>	<u>Maximum Acceptable Concentration</u>	<u>Reference</u>
Alkalinity (Total, as CaCO_3) ¹	1000 mg/L	Manitoba Agriculture
Aluminum (Total)	5.0 mg/L	NAS/NAE (1973)
Arsenic (Total)	0.5 mg/L	Environment Canada (1979)
Boron (Total)	5.0 mg/L	NAS/NAE (1973)
Cadmium (Total)	0.02 mg/L	Environment Canada (1979)
Chromium (Total)	1.0 mg/L	Environment Canada (1979)
Cobalt (Total)	1.0 mg/L	NAS/NAE (1973)
Conductivity	4300 $\mu\text{S}/\text{cm}$	Manitoba Agriculture
Copper (Total)	1.0 mg/L	Environment Canada (1979)
Dissolved oxygen	maintain aerobic conditions	NAS/NAE (1973)
Filterable residue	3000 mg/L	NAS/NAE (1973)
Fluoride (Total)	2.0 mg/L	NAS/NAE (1973)
Lead (Total)	0.5 mg/L	Environment Canada (1979)

Mercury (Total)	0.003 mg/L	Environment Canada (1979)
Nickel (Total)	5.0 mg/L	Environment Canada (1979)
Nitrate - Nitrite (NO ₃ - NO ₂)	10.0 mg/L	Best professional judgement (Manitoba Agriculture)
pH	5.5-9.0 pH units	Manitoba Agriculture
Radionuclides	The limits from the preceding Section 2.1.1.5, RECOMMENDED LIMITS FOR RADIONUCLIDES, should apply.	Health and Welfare Canada (1978)
Selenium (Total)	0.05 mg/L	Environment Canada (1979)
Sulfate (SO ₄) ¹	1000 mg/L	Manitoba Agriculture
Toxic algae	Waters bearing heavy growths of blue green algae should be avoided.	Manitoba Agriculture
Vanadium (Total)	0.1 mg/L	NAS/NAE (1973)
Zinc (Total)	50.0 mg/L	Environment Canada (1979)

1. Alkalinity (Total, as CaCO₃) plus Sulfate (SO₄) should not exceed 1000 mg/L (Best professional judgement, Manitoba Agriculture).

2.5 CLASS 5: RECREATION

Surface waters provide outdoor recreational opportunities for both Manitoba residents and tourists. This class will ensure that such waters may be safely used for swimming and boating purposes and also may provide for the enjoyment of pleasant scenery.

2.5.1 CATEGORY A: PRIMARY RECREATION

This category will ensure the protection of waters which are suitable for primary recreational uses where the human body may come in direct contact

with the water, to the point that water may be ingested accidentally or water may contact certain sensitive organs such as the eyes, ears and nose. Examples could include wading and dabbling, swimming, diving, water skiing, surfing and intimate contact with water directly associated with shoreline activities. Due to climatic conditions in Manitoba, primary recreation is usually restricted to the period from May 1 to September 30 of the same year.

2.5.1.1 SPECIFIC REQUIREMENTS

<u>Parameter</u>	<u>Maximum Acceptable Concentration</u>	<u>Reference</u>
Clarity (Secchi disc visibility)	1.2 meters (minimum)	Health and Welfare Canada (1983)
Dissolved oxygen	maintain aerobic conditions	Best professional judgement (Environmental Management Division)
Fecal coliform bacteria	(a) geometric mean: 200 organisms /100 mL (b) individual maximum: 400 organisms/100 mL (sufficient samples should be collected in order to permit valid interpretation)	Health and Welfare Canada (1983)
pH	6.5-8.5 pH units	Health and Welfare Canada (1983)
Turbidity	50 Jackson Turbidity Units	Health and Welfare Canada (1983)

2.5.2 CATEGORY B: SECONDARY RECREATION

This category will provide protection to waters which are suitable for boating, fishing and other water related activities other than immersion recreation, including navigation and aesthetic enjoyment of scenery. This category includes activities in which water use is incidental, accidental or sensory, and includes fishing, boating, camping, hunting and hiking.



Figure 10: Manitoba's surface waters provide an aesthetically pleasing setting for the enjoyment of secondary recreational pursuits, such as angling.



Figure 11: The assimilative capacity of streams, such as the Winnipeg River, is used to dispose of liquid waste effluents.

2.5.2.1 SPECIFIC REQUIREMENTS

<u>Parameter</u>	<u>Maximum Acceptable Concentration</u>	<u>Reference</u>
Dissolved oxygen	maintain aerobic conditions	EPA (1976)
Fecal coliform bacteria	(a) geometric mean: 1000 organisms /100 mL (b) individual maximum: 2000 organisms/100 mL (sufficient samples should be collected in order to permit valid interpretation).	Best professional judgement (Environmental Management Division)
Navigational hazards	There should be no unmarked submergent or emergent obstructions that pose a threat to navigation.	Best professional judgement (Environmental Management Division)
Temperature	There should be no temperature changes that interfere with the natural freezing patterns or dates that pose a threat to navigation.	Best professional judgement (Environmental Management Division)

2.6 CLASS 6: OTHER USES

The uses to be protected in this class may be under other jurisdictions and in other areas to which the waters of the Province are tributary and may include any or all of the uses listed in the preceding categories, plus any other possible beneficial uses. The Environmental Management Division, therefore, reserves the right to designate any objective necessary for the protection of this class, consistent with legal limitations.

The Environmental Management Division is also cognizant of the fact that other uses of streams, rivers or lakes may also include the removal of excess precipitation, production of hydroelectric power or disposal of wastes. These are beneficial uses, however, they do not require protection through the designation of objectives. These uses, however may be chosen on the basis of social or economic conditions to take precedence over the other preceding designated beneficial uses.

3. REFERENCES

- Alabaster, J.S; Lloyd, R, 1982: Water Quality Criteria for Freshwater Fish. Second Edition. Food and Agriculture Organization of the United Nations, Butterworths, 361 pages.
- Davis, J.C. 1975: Waterborne Dissolved Oxygen Requirements and Criteria with Particular Emphasis on the Canadian Environment. National Research Council of Canada, NRC Associate Committee on Scientific Criteria for Environmental Quality, Report No. 13, Environmental Secretariat Publication No. NRCC 14100, Ottawa, Canada. 111 pages.
- Environment Canada, 1979: Guidelines for Surface Water Quality. Vol. 1, Inorganic Chemical Substances. Inland Waters Directorate, Water Quality Branch, Ottawa, Canada.
- Environment Canada, 1983: Guidelines for Surface Water Quality. Vol. 2, Organic Chemical Substances. Inland Waters Directorate, Water Quality Branch, Ottawa, Canada.
- Environmental Protection Agency, 1976: Quality Criteria for Water, United States Environmental Protection Agency, Washington, D.C. 20460.
- Environmental Protection Agency, 1980: Water Quality Criteria Documents Availability, Federal Register Vol. 45, No. 231, Friday, November 28, 1980 (FRL1623-3) 79318-79379.
- Health and Welfare, Canada, 1978: Guidelines for Canadian Drinking Water Quality. Federal-Provincial Working Group on Drinking Water of the Federal-Provincial Advisory Committee on Environmental and Occupational Health. 76 pages.
- Health and Welfare, Canada, 1983: Guidelines for Canadian Recreational Water Quality. Federal-Provincial Working Group on Recreational Water Quality of the Federal-Provincial Advisory Committee on Environmental and Occupational Health. 75 pages
- Manitoba Department of Agriculture: Manitoba Agriculture Farm Facts, Livestock Water Quality. Agdex 716/13 00.
- National Academy of Sciences/National Academy of Engineering, 1973: Water Quality Criteria, 1972. EPA.R3.73.033. March, 1973. 594 pages.

APPENDIX 1

TABLE 1: General and specific surface water quality objectives for the Province of Manitoba.

	Class 1: Domestic Consumption	Class 2: Aquatic Life and Wildlife Category A: Cold Water Aquatic Life, Cold Water Aquatic Life, Wildlife	Class 2: Aquatic Life and Wildlife Category B: Cold Water Aquatic Life, Wildlife	Class 3: Industrial Consumption	Class 4: Agricultural Consumption Category A: Irrigation (Sole Source of Water)	Class 4: Agricultural Consumption Category B: Irrigation (Supplemental Source of Water)	Class 4: Agricultural Consumption Category C: Irrigation (Qualified Use of Water)	Class 4: Agricultural Consumption Category D: Livestock	Class 5: Recreation Category A: Primary Recreation	Class 5: Recreation Category B: Secondary Recreation	Class 6: Other Uses
Ammonia (un-ionized, NH ₃)		0.02 mg/L (3)	0.02 mg/L								
Aldrin + Dieldrin (2)	0.0007 mg/L										
Alkalinity (Total, as CaCO ₃)								1000 mg/L (4)			
Aluminum (Total)					5.0 mg/L	5.0 mg/L	20.0 mg/L	5.0 mg/L			
Antimony (Total)	0.0002 mg/L										
Arsenic (Total)	0.05 mg/L	0.05 mg/L	0.05 mg/L		0.1 mg/L	0.1 mg/L	2.0 mg/L	0.5 mg/L			
Barium (Total)	1.0 mg/L										
Beryllium (Total)					0.1 mg/L	0.1 mg/L	0.5 mg/L				
Boron (Total)	5.0 mg/L				0.5 mg/L	1.0 mg/L	2.0 mg/L	5.0 mg/L			
Cadmium (Total)	0.005 mg/L	(1.05 (ln (hardness)) - 8.53) where hardness is expressed in mg/L as CaCO ₃ , (eg) 50 mg/L CaCO ₃ ≡ 0.012 ug/L 100 mg/L CaCO ₃ ≡ 0.025 ug/L 200 mg/L CaCO ₃ ≡ 0.051 ug/L	(1.05 (ln (hardness)) - 8.53) where hardness is expressed in mg/L as CaCO ₃ , (eg) 50 mg/L CaCO ₃ ≡ 0.012 ug/L 100 mg/L CaCO ₃ ≡ 0.025 ug/L 200 mg/L CaCO ₃ ≡ 0.051 ug/L		0.01 mg/L	0.01 mg/L	0.01 mg/L	0.02 mg/L			
Carbaryl (2)	0.07 mg/L										
Cesium - 137 (1)	50 Bq/L				50 Bq/L	50 Bq/L	50 Bq/L	50 Bq/L			
Chlordane (Total isomers)	0.007 mg/L										
Chlordane		0.0043 ug/L	0.0043 ug/L								
Chloride	250 mg/L				68 mg/L	150 mg/L	150 mg/L				
Chlorine (Total residual)		0.002 mg/L	0.01 mg/L								
Chromium (Total)	0.05 mg/L				0.1 mg/L	0.1 mg/L	1.0 mg/L	1.0 mg/L			
Chromium (Total hexavalent)		0.29 ug/L	0.29 ug/L								
Clarity (Secchi disc visibility)									1.2 meters		
Cobalt (Total)					0.05 mg/L	0.05 mg/L	5.0 mg/L	1.0 mg/L			
Colour, odour, taste, turbidity	Free from materials that produce colour, odour, taste, turbidity or other conditions in such a degree as to be objectionable or to impair any beneficial use.										
Colour	15 True Colour Units										
Conductivity					1000 uS/cm	1500 uS/cm	2000 uS/cm	4300 uS/cm			
Copper (Total)	1.0 mg/L	5.6 ug/L	5.6 ug/L		0.2 mg/L	0.2 mg/L	5.0 mg/L	1.0 mg/L			
Cyanide, Free (sum of HCN and CN, expressed as CN)	0.2 mg/L	3.5 ug/L	3.5 ug/L								
Deposits	None that will cause the formation of putrescent or otherwise objectionable sludge deposits.										
DDT and metabolites		0.0010 ug/L	0.0010 ug/L								
DDT (Total isomers) (2)	0.03 mg/L										
Diazinon (2)	0.014 mg/L										
Dieldrin		0.0019 ug/L	0.0019 ug/L								
Dissolved oxygen		60% saturation (instantaneous minimum)	47% saturation (instantaneous minimum)					maintain aerobic conditions	maintain aerobic conditions	maintain aerobic conditions	
Endosulfan		0.056 ug/L	0.056 ug/L								
Endrin (2)	0.0002 mg/L	0.0023 ug/L	0.0023 ug/L								
Fecal coliform bacteria	90 percentile: 10 organisms/100 mL				a) geometric mean: 1000 organisms/100 mL b) individual maximum:	a) geometric mean: 1000 organisms/100 mL b) individual maximum:	a) geometric mean: 1000 organisms/100 mL b) individual maximum:	a) geometric mean: 200 organisms/ 100 mL	a) geometric mean: 1000 organisms/ 100 mL		

[illegible]

		where hardness is expressed in mg/L CaCO ₃ (eg) 50 mg/L CaCO ₃ = 56 ug/L 100 mg/L CaCO ₃ = 96 ug/L 200 mg/L CaCO ₃ = 160 ug/L	where hardness is expressed in mg/L CaCO ₃ (eg) 50 mg/L CaCO ₃ = 56 ug/L 100 mg/L CaCO ₃ = 96 ug/L 200 mg/L CaCO ₃ = 160 ug/L						
Nitrate plus Nitrite	10.0 mg/L								10.0 mg/L
Nitrate (NO ₃)	10.0 mg/L								
Nitrilotriacetic Acid (NTA)	0.05 mg/L								
Nitrite (NO ₂)	1.0 mg/L								
Non-filterable residue	25 mg/L	25 mg/L							
Nutrients	Nitrogen, phosphorus, carbon and contributing trace elements should be limited to the extent necessary to prevent the nuisance growth and reproduction of aquatic rooted, attached and floating plants, fungi or bacteria or to otherwise render the water unsuitable for other beneficial uses. For general guidance, unless it can be demonstrated that total phosphorus is not a limiting factor, considering the morphological, physical, chemical or other characteristics of the water body, total phosphorus should not exceed 0.025 mg/L in any reservoir, lake, pond, or in a tributary at the point where it enters such bodies of waters. In addition, total phosphorus should not exceed 0.05 mg/L in any stream except those identified in the preceding statement. It should be noted that maintenance of such concentrations may not guarantee that eutrophication problems will not develop.								
Odour (see also Colour, odour, taste, turbidity)	Inoffensive								
Oil and Grease	Free from oil and grease residues which causes a visible film or sheen upon the waters or any discolouration of the surface of adjoining shorelines or causes a sludge or emulsion to be deposited beneath the surface of the water or upon the adjoining shorelines.								
Parathion (2)	0.035 mg/L								
Pesticides (Total) (2)	0.1 mg/L								
pH	6.5-8.5 pH units	6.5-9.0 pH units	6.5-9.0 pH units	6.0-8.5 pH units	5.0-9.0 pH units	5.0-9.0 pH units	5.5-9.0 pH units	6.5-8.5 pH units	
Phenols	0.002 mg/L	1.0 ug/L	1.0 ug/L						
Phthalic acid esters									
(i) Dibutylphthalate (DBP)		4.0 ug/L	4.0 ug/L						
(ii) Di-(2-ethylhexyl) phthalate (DEHP)		0.6 ug/L	0.6 ug/L						
(iii) Other phthalates		0.2 ug/L	0.2 ug/L						
Polychlorinated biphenyls		0.014 ug/L	0.014 ug/L						
Radionuclides (see Cesium - 137, Iodine - 131, Radium - 226 Strontium - 90 and Tritium) (1)									
Radium - 226 (1)	1 Bq/L			1 Bq/L	1 Bq/L	1 Bq/L	1 Bq/L		
Selenium (Total)	0.01 mg/L			0.02 mg/L	0.02 mg/L	0.05 mg/L	0.05 mg/L		
Selenium (Total selenite)		35 ug/L	35 ug/L						
Silver (Total)	0.05 mg/L	0.1 ug/L	0.1 ug/L						
Sodium	400 mg/L			a) 20 mg/L b) 4.0 SAR (3) SAR = $\frac{.043Na}{\sqrt{.025Ca+.04 Mg}}$ expressed in mg/L	6.0 SAR SAR = $\frac{.043Na}{\sqrt{.025Ca+.04 Mg}}$ expressed in mg/L	8.0 SAR SAR = $\frac{.043Na}{\sqrt{.025Ca+.04 Mg}}$ expressed in mg/L			
Specific conductivity (see Conductivity)									
Strontium - 90 (1)	10 Bq/L			10 Bq/L	10 Bq/L	10 Bq/L	10 Bq/L		
Sulfates (SO ₄)	500 mg/L			250 mg/L	250 mg/L	250 mg/L	1000 mg/L		
Sulfides (see Hydrogen sulfide)									
Taste (see also Colour, odour, taste, turbidity)	Inoffensive								
Temperature		Site specific objectives will be developed considering the guidelines in Section 2.2.1.1.	Site specific objectives will be developed considering the guidelines in Section 2.2.1.1.						There should be no temperature changes that interfere with the natural freezing patterns or dates that pose a threat to navigation
Total coliform bacteria	90 percentile: 100 organisms/100 mL								
Total dissolved solids (see Filterable residue)									
Toxaphene	0.005 mg/L	0.013 ug/L	0.013 ug/L						
Toxic Algae									Waters bearing heavy growths of

Radium - 226 (1)	1 Bq/L			1 Bq/L	1 Bq/L	1 Bq/L	1 Bq/L
Selenium (Total)	0.01 mg/L			0.02 mg/L	0.02 mg/L	0.05 mg/L	0.05 mg/L
Selenium (Total selenite)		35 ug/L	35 ug/L				
Silver (Total)	0.05 mg/L	0.1 ug/L	0.1 ug/L				
Sodium	400 mg/L			a) 20 mg/L b) 4.0 SAR (3) $SAR = \frac{.043Na}{\sqrt{.025Ca+.04 Mg}}$ expressed in mg/L	6.0 SAR $SAR = \frac{.043Na}{\sqrt{.025Ca+.04 Mg}}$ expressed in mg/L	8.0 SAR $SAR = \frac{.043Na}{\sqrt{.025Ca+.04 Mg}}$ expressed in mg/L	
Specific conductivity (see Conductivity)							
Strontium - 90 (1)	10 Bq/L			10 Bq/L	10 Bq/L	10 Bq/L	10 Bq/L
Sulfates (SO ₄)	500 mg/L			250 mg/L	250 mg/L	250 mg/L	1000 mg/L
Sulfides (see Hydrogen sulfide)							
Taste (see also Colour, odour, taste, turbidity)	Inoffensive						
Temperature		Site specific objectives will be developed considering the guidelines in Section 2.2.1.1.	Site specific objectives will be developed considering the guidelines in Section 2.2.1.1.				There should be no temperature changes that interfere with the natural freezing patterns or dates that pose a threat to navigation
Total coliform bacteria	90 percentile: 100 organisms/100 mL						
Total dissolved solids (see Filterable residue)							
Toxaphene	0.005 mg/L	0.013 ug/L	0.013 ug/L				
Toxic Algae							Waters bearing heavy growths of blue green algae should be avoided.
Toxic substances	Free from substances in concentrations or in combinations that injure, be toxic to, or produce adverse physiological or behavioral responses in humans, aquatic, semi-aquatic and terrestrial life.						
Trihalomethanes, total potential (chloroform, bromodichloromethane, chlorodibromomethane and bromoform)	0.35 mg/L						
Tritium (1)	40000 Bq/L			40000 Bq/L	40000 Bq/L	40000 Bq/L	40000 Bq/L
Turbidity (see also Colour, odour, taste, turbidity)	5 Nephelometric Turbidity Unit						50 Jackson Turbidity Units
Uranium	0.02 mg/L						
Unspecified substances	Objectives will be developed by the methods outlined in Section 1.6.						
Vanadium				0.1 mg/L	0.1 mg/L	1.0 mg/L	0.1 mg/L
Zinc (Total)	5.0 mg/L	47 ug/L	47 ug/L	2.0 mg/L	2.0 mg/L	10.0 mg/L	50.0 mg/L
2,4 -D (2)	0.1 mg/L						
2, 4, 5 -TP (2)	0.01 mg/L						

Notes:

(1) Where two or more radionuclides affecting the same organ or tissue are found to be present, the following relationship, based on the International Commission on Radiological Protection publication 26, should be satisfied: $\frac{C_1}{C_1} + \frac{C_2}{C_2} + \frac{C_3}{C_3} = 1$, where C_1, C_2, C_3 are the observed concentrations, and C_1, C_2, C_3 are the maximum acceptable concentrations for each contributing radionuclide.

(2) When more than one pesticide is present, the sum of their concentrations should not exceed 0.1 mg/L.

(3) Abbreviations: (a) Bq/L = Becquerels per liter
(b) ug/L = micrograms per liter
(c) uS/L = microsiemens per centimeter
(d) mg/L = milligrams per liter
(e) SAR = Sodium Adsorption Ratio

(4) Alkalinity (Total as CaCO₃) plus sulfate (SO₄) should not exceed 1000 mg/L.

Number/ Numéro

2



MANIT^{BA}

**Department of Environment and
Workplace Safety and Health**

Surface Water Quality Management Proposal

Volume 2: Watershed Classifications

Water Standards and Studies Report #83-3

SURFACE WATER QUALITY

MANAGEMENT PROPOSAL

Volume 2: Watershed Classifications

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WATER STANDARDS AND STUDIES REPORT 83-3

SUMMARY

Watershed Classification is a process through which uses are identified for bodies of water, then objectives are applied that will protect those uses. For example, through this process it may be determined that it is desirable to maintain certain lakes or rivers for drinking purposes or for recreational activities. The objectives that will protect these uses (from Volume 1 of this document) are then applied.

The Province of Manitoba has been divided into nineteen natural watersheds. Each watershed will be classified individually.

Watershed classification is a complex process that involves input from numerous government agencies, industries, municipalities and most important, from private citizens.

Information must be analyzed in order to determine the present and potential uses of certain bodies of water, how the uses are affected by water quality and the social or economic value of each use. This information is organized by the Environmental Management Division in the form of a Watershed Classification Proposal.

The Clean Environment Commission then holds public hearings in order for all interested parties to participate in the further development of this proposal.

Following completion of this classification proposal to the satisfaction of the elected provincial representatives, it is the intent that all government agencies should use this classification as policy when dealing with matters related to water quality.

Because watershed classification is a lengthy process, the majority of Manitoba's waterways have yet to be classified. Therefore, surface water quality objectives from Volume 1 of this document should be applied on a site-specific basis in order to protect the present uses of such watersheds. For example, when considering restrictions on a discharge within a watershed that has not been classified, and it is known that such waters are used for drinking purposes, the objectives for domestic consumption should be used in order to provide adequate protection.

PREAMBLE

In 1976, the Environmental Management Division prepared a proposal outlining a system of surface water quality objectives and watershed classifications for the Province of Manitoba that would form the basis of a surface water quality management program. This proposal was critically reviewed by the Clean Environment Commission through public hearings held in 1977, under Section 13.1 of the Clean Environment Act. It was subsequently implemented with several revisions resulting from the public hearings.

Volume 1, Surface Water Quality Objectives, under separate cover, contains revised objectives which reflect current scientific knowledge and which delineate numerous changes in the water use classes and categories in order to better reflect the surface water use within Manitoba. Specific problem areas encountered in the original objectives have been further defined.

Volume 2, Watershed Classifications, herein, contains a revised procedure for the application of surface water quality objectives.

This document also contains a procedure for utilizing the surface water quality objectives, on an interim basis for watersheds that have not been classified. The surface water quality objectives will be appended for each of the nineteen watersheds within Manitoba as they become available.

The attached documents have been prepared by the Water Standards and Studies Section of the Environmental Management Division and have been reviewed by the Water Pollution Control Section of the

Environmental Management Division, the Manitoba Departments of Agriculture, Municipal Affairs, Health, Urban Affairs, Economic Development and Tourism, Energy and Mines, and the Parks, Wildlife, Resource Allocation, Fisheries and Water Resources Branches of the Manitoba Department of Natural Resources.

FOR FURTHER INFORMATION ON THE SURFACE WATER QUALITY OBJECTIVES OR WATERSHED CLASSIFICATION, PLEASE CONTACT:

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1. INTRODUCTION

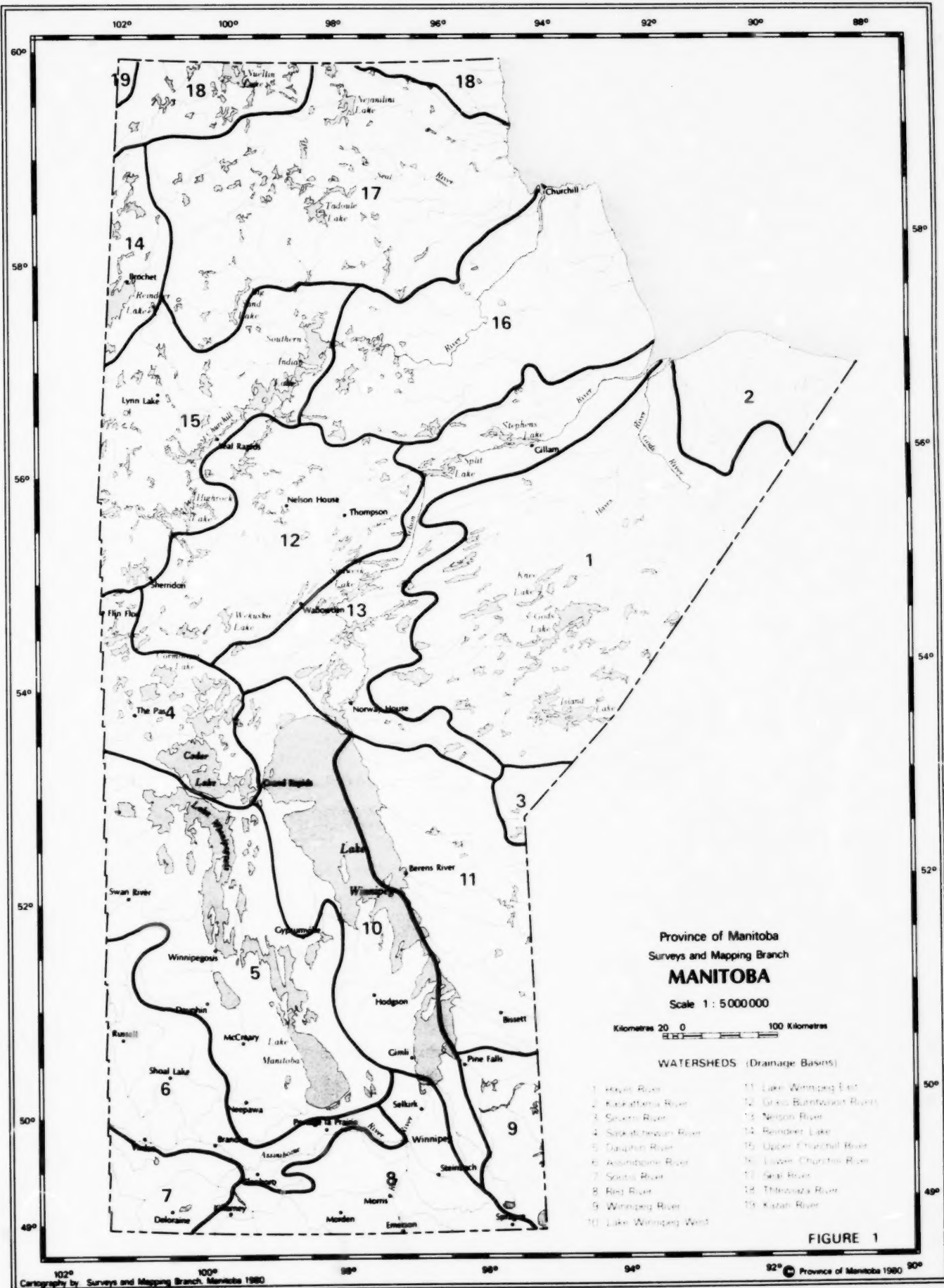
Watershed classification is a management process whereby surface water quality objectives are applied to individual streams, stream segments, lakes, other water courses or entire watersheds in order to maintain, protect or enhance the beneficial uses of those waters. Beneficial present and potential uses, plus the surface water quality objectives necessary to protect those uses with an adequate degree of safety, are detailed in Volume I, Surface Water Quality Objectives, of this document.

The Province of Manitoba has been divided into nineteen natural watersheds (Figure 1). Each watershed will be classified individually.

2. PROCEDURE FOR THE CLASSIFICATION OF WATERSHEDS

The process of watershed classification does not readily subscribe to well defined criteria, but relies upon common sense and practical application of limited resources. Decisions and general consensus are reached through open and broad ranging debate with those affected by the decisions. The process requires flexibility in order to consider the unique chemical, physical, biological, aesthetic and social-economic characteristics of each watershed related to determining its best usage. The following general guidelines should be considered during this process:

- 1.) Through the co-ordination of the Environmental Management Division, representatives of various related provincial and federal departments of government are assembled for the purpose of gathering and analyzing information. Representatives should include, but not be limited to, staff of the Manitoba Departments of Agriculture, Municipal Affairs, Economic Development and Tourism, Urban Affairs, Energy and Mines, Health and the Parks, Wildlife, Fisheries, Water Resources and



Resource Allocation Branches of the Manitoba Department of Natural Resources. Information may be solicited from the general public, various private agencies such as academic groups, consulting firms, universities and colleges, plus agencies from adjoining provinces or states should the watershed under consideration be interprovincial or international in nature.

Sufficient chemical, biological and physical data should be evaluated in order to adequately define the beneficial present or potential uses. Information analyses should include what the use is, how the use is characterized in terms of chemical, biological, physical and aesthetic characteristics and the social or economic value of each use.

If adequate data do not exist, especially on priority water courses, water quality studies should be conducted. Interim classifications should be proposed for watersheds for which sufficient data do not exist and for which resources are unavailable for collecting the necessary information.

- 2.) The analyses of information may indicate that the best usage of the surface waters being considered are those uses that presently exist. The analyses may indicate that the present uses are being adequately achieved and are not being jeopardized because of inferior or degraded water quality. Surface water quality objectives should then be recommended that would maintain the present beneficial uses.

However, the analyses of information may indicate that the best usage of the surface waters being considered are presently not attainable. In order to achieve the best usage, the surface water quality must be enhanced or improved. Questions that require satisfactory responses are:

- (a) What are the uses?
- (b) What are the limiting water quality variables?

- (c) To what extent does pollution contribute to the impairment of the uses?
- (d) What is the level of point source pollution control necessary to enhance or improve the use?
- (e) What is the level of non-point source pollution control necessary to enhance or improve the use?
- (f) Does the cost of attaining and protecting the use bear a reasonable relationship to the benefits?

Surface water quality objectives should then be recommended that would adequately maintain, enhance or protect the beneficial surface water uses.

For waters with multiple use designations, the objectives should protect the most sensitive use. The objectives should also take into consideration the protection of uses on a seasonal basis. In addition, site specific objectives developed from those in Volume 1 of this document, should be recommended when necessary, to take into consideration local water quality characteristics or varying sensitivities of local aquatic communities.

- 3.) All necessary and pertinent information should be compiled in a sufficiently clear and concise format in order that reasoned criticisms, challenges and/or support may be solicited from professional peer groups, industries, municipalities, private agencies and the general public. Since watershed classification affects most Manitobans, the proposal should be easily understood by those affected by the decisions. The proposal should also reflect the aspirations of most Manitobans. The success of watershed classification rests with the achievement of these goals.

To this end, the watershed classification proposal should be submitted to the Clean Environment Commission and should be

subsequently distributed to all concerned and affected parties. The Clean Environment Commission should conduct public hearings to ensure that all interested parties are heard. Following completion of the public hearings the Clean Environment Commission should submit a report to the Minister detailing the findings of their investigations.

4.) Upon receipt of the Clean Environment Commission report, the Minister may:

- i) accept the watershed classification proposal as submitted,
- ii) request additional information for clarification purposes, and/or
- iii) request further Environmental Management Division watershed classification proposals, and/or
- iv) request further Clean Environment Commission investigations, and/or
- v) require additional information or investigations as deemed necessary.

5.) Following the finalization of each of the nineteen watershed classification proposals to the satisfaction of the Minister, the proposal should be adopted as policy. The Government should utilize this policy when dealing with all matters related to water quality.

6.) Due to changing use patterns and priorities, changes in watershed classification may be proposed at any time. The above general guidelines should be followed when considering re-classifications.

3. UTILIZATION OF SURFACE WATER QUALITY OBJECTIVES WITHIN
WATERSHEDS THAT HAVE NOT RECEIVED FINALIZED WATERSHED
CLASSIFICATIONS.

The surface water quality objectives, detailed in Volume 1 of this

document, should be applied on a site specific basis within watersheds for which a watershed classification proposal has not been adopted as policy. Best professional judgement should be used to interpret the surface water quality objectives necessary to protect all present beneficial uses.

POOR

QUALITY

ORIGINAL